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NEONATAL MECHANICAL VENTILATION OUR 1 YEAR EXPERIENCE AT A RURAL HOSPITAL

Neonatology

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ABSTRACT

Background: Neonatal mortality accounts for nearly two thirds of infant mortality and half of under 5 mortalities in India. So, mechanical ventilation has become a must to enhance neonatal survival and is an essential component of neonatal intensive care.

Objective: To determine the common indications and outcome of neonates requiring mechanical ventilation in neonatal intensive care unit.

Method: This was a Prospective Observational study conducted on neonates who required mechanical ventilation over a period of 1 year (1st September 2015 –1st September 2016). Neonates admitted in NICU, requiring mechanical ventilation after taking an informed consent were enrolled in our study. Clinical course of the neonate including Indication of Ventilation and Complications were observed and studied in NICU. Details were entered in predesigned validated proforma and outcome as Survival/Death noted.

Results: 103 neonates were ventilated over a period of 1 year, of whom 47 (45.6%) survived. The most common indication of ventilation were Birth asphyxia (30.1%), neonatal sepsis (21.4%), respiratory distress syndrome (19.4%) and congestive heart failure (9.7%). Survival rate was maximum in neonates with birth weight >2.5kg (58.6%) and >1.5kg - 2.5kg (56.5%) and least in neonates with birth weight <1.5kg (14.3%). Most common complication were Ventilator associated pneumonia (48.7%) and Sepsis (40.54%). 45.6% of neonates survived.

Conclusion: Judicial use of neonatal intensive care measures in a developing country can result in a reduction of morbidity and mortality.

KEYWORDS

Mechanical ventilation; Respiratory distress syndrome

INTRODUCTION:

Assisted ventilation has become an indispensable part of neonatal intensive care[1]. The introduction of mechanical ventilation in the 1960s was one of the major new interventions in neonatology, which provided life-saving support for infants with cardiorespiratory failure[2]. It is possible to increase survival of neonates and improve the quality of life only through prompt and adequate management of neonates which is not possible without respiratory intensive care and assisted ventilation. Thus, It has become essential and mandatory to establish neonatal advanced life support facilities in Neonatal Intensive Care Units to enhance newborn survival[3]. Mechanical ventilation refers to various artificial means to support oxygenation and ventilation. Emerson first used artificial positive pressure ventilation in operating room with anaesthesia. Since then mechanical ventilation has revolutionized our management of critically ill patients[4,5]. The data provided by Marketstrat, Inca company that analyzes such global information, shows that the number of ventilator purchases in India has been increasing at a steady rate of 3% to 4% per year[6].

This study was done to assess the current status of neonatal ventilation in a tertiary care neonatal unit in India, to identify the common indications for ventilation, study the course during ventilation, analyze the complications that arise, and evaluate the final outcome as measured by survival.

MATERIALS AND METHODS:

Place of the Study: Neonatal Intensive Care Unit (NICU), Department of Pediatrics, Acharya Vinobha Bhave Rural Hospital, Sawangi (M), Wardha.

STUDY DESIGN: Prospective Observational Study.

SAMPLE SIZE: All neonates requiring assisted ventilation during the study period.

STUDY DURATION: 1st September 2015 – 1st September 2016 (1 year)

INCLUSION CRITERIA:

Neonates who receive mechanical ventilation for minimum of 6 hours.

EXCLUSION CRITERIA:

1. Babies who expire within 6 hours of life.
2. Neonates with birth weight < 500 grams.
3. Abrupt termination of ventilator support for any reason.
4. Gestational age <26 weeks.

The data regarding patients requiring mechanical ventilation from 1st September 2015 –1st September 2016 (1 year) was retrieved from the case sheets and monitoring charts in Neonatal Intensive Care Unit. Neonatal characteristics and demographic factors like age, sex, weight, gestational age by Ballard Score was noted. Information about neonate being Term/Preterm/Post-term was taken. Congenital abnormalities if any were noted. Resuscitation method for neonate was noted. APGAR score was taken at 1 minute and at 5 minutes. . Detailed maternal history was taken for risk factors. History of maternal health conditions was noted. Type of delivery Vaginal / LSCS was noted along with the presentation of fetus. Babies were nursed under servo control open care system. Continuous clinical monitoring of vitals, retractions, chest expansion, air entry, capillary refilling time, peripheral pulses, status of hydration and oxygen saturation was done. Arterial Blood Gas analysis by radial artery puncture was done at the initiation of ventilation and whenever required. Relevant investigations such as complete blood counts, chest X-ray, kidney function test, liver function test, blood culture, cerebrospinal fluid analysis, blood sugar, serum calcium, cranial ultrasound, etc., were done and repeated as required. Whenever clinically indicated, Sepsis work-up was done. Whenever septicemia or pneumonia was suspected, endotracheal tube and blood culture sensitivity was ordered. Apnea is pathologic (an apneic spell) when absent airflow is prolonged (usually 20 seconds or more) or accompanied by bradycardia (heart rate <100 beats per minute) or hypoxemia that is detected clinically (cyanosis) or by oxygen saturation monitoring.

RDS was suspected in a preterm infant, typically <34 weeks' gestation, with signs of respiratory distress that develop soon after birth. PPHN was suspected when a gradient of 10% or more in oxygenation saturation between simultaneous preductal (right upper extremity) and postductal (lower extremity) arterial blood gas (ABG) values or transcutaneous oxygen saturation (SaO2) measurements documents the presence of a ductus arteriosus right-to-left hemodynamic shunt and, in the absence of structural heart disease.

Ventilatory parameters were recorded twice daily for each patient. All the relevant investigations were recorded. Complications encountered

during ventilation were recorded. Outcome was noted as Discharge or Death. The results obtained were tabulated and analysed using appropriate statistical programme, Statistical Package for Social Sciences (SPSS), version 17.0 and Graph Pad Prism 5.0.

The results were compared using the Chi square test and multiple logistic regression, p value was calculated.

RESULTS:

A total of 103 neonates were mechanically ventilated during the study period. Survival was seen 47 neonates (45.6%), mortality being 54.4%. Males were 59 (57.3%) and females were 44 (42.7%). Male Female ratio in this study was 1.34:1(Table 1, Fig 1).

49 neonates were fullterm which constituted 47.6%, and 54 were preterms, comprising of 52.4% (Fig 2). 29 neonates (28.1%) had normal weight i.e. >2.5kg; while 74 (71.9%) were Low Birth Weight babies (Fig 3). 56 neonates (54.3%) were born via vaginal delivery.

Table 1: Sex Distribution Of Neonates:

	Number	Percentage
Male	59	57.3%
Female	44	42.7%
Total	103	100%

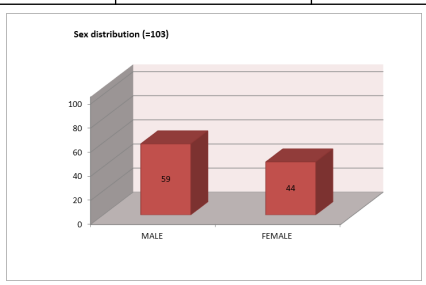

Fig 1: Sex Distribution Of Neonates:

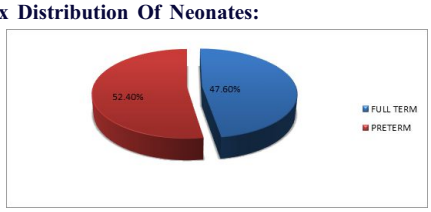

Fig 2: Distribution of Neonates based on Gestation

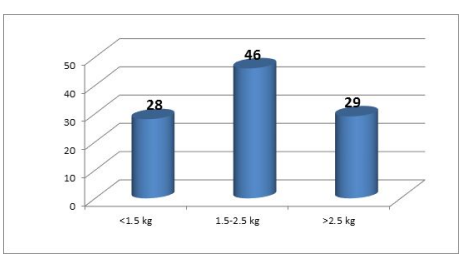

Fig 3: Distribution of Neonates based on Birth Weight

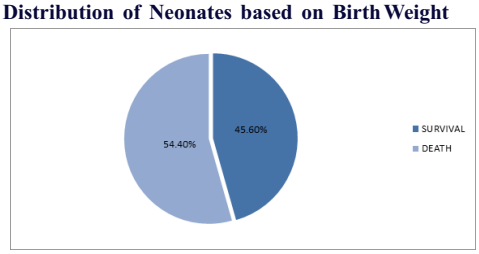

Fig 4: Short term outcome of neonates

The most common indication of ventilation observed was Birth Asphyxia reported in 31 neonates (30.1%), and Neonatal Sepsis in 22 neonates (21.4%). Other common indications were Respiratory Distress Syndrome in 20 neonates (19.4%) and Congestive Heart Failure in 10 neonates (9.7%). Respiratory Distress Syndrome was more seen in males (65%) than females (35%) (Table 2, Table 3).

Table 2: Indication of ventilation:

Indication	Total No.	Percentage
Asphyxia	31	30.1%
Neonatal sepsis	22	21.4%
Respiratory distress syndrome	20	19.4%
Congestive heart failure	10	09.7%
Apnea of prematurity	5	04.9%
Tracheo-esophageal fistula	4	03.9%
Congenital diaphragmatic hernia	4	03.9%
Meconium aspiration syndrome	3	02.9%
Meningitis	3	02.9%
Persistant pulmonary hypertension of newborn	1	1%
Total	103	100%

Table 3: Distribution of neonates with RDS:

RDS		
	Number of Patients	Percentage
Male	13	65%
Female	7	35%

Table 4: Maternal Illness:

Maternal Illness	Total number	Percentage
Pregnancy induced hypertension	20	19.4%
Oligohydramnios	18	17.5%
Severe anemia	9	8.8%
Eclampsia	7	6.8%
Antepartum hemorrhage	4	3.9%
Bad obstetric history	2	2%
Others	2	2%
Total	62	100%

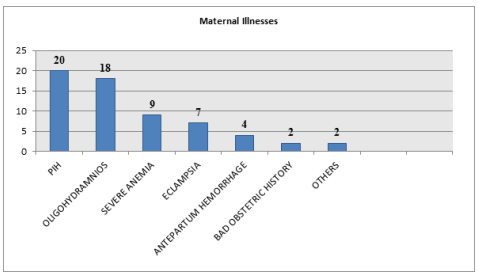

Fig 5: Maternal Illness

Of the 103 neonates, maternal complications was seen in 62 (60.1%) neonates like pregnancy induced hypertension (19.4%), oligohydramnios (17.5%), severe anemia (8.8%), eclampsia (6.8%) and antepartum hemorrhage (3.9%) (Table 4, Fig 5) .

Table 5: Ventilatory parameters:

Parameter	Mean	Median	Mode
PIP	14.14(10-24)	13	12
PEEP	6.35(4-9)	6	6
Set Rate	39.05(30-46)	40	40
FiO2	0.79 (0.3-1)	0.9	1
Tidal volume	8.39 (6-10)	9	9

PIP settings ranged from minimum of 10 to a maximum of 24. was set at minimum at the start of ventilation and was increased as required. Similarly, PEEP had a range from 4 to a maximum of 9. The Set Respiratory rate hovered around 40. FiO2 was ranged from 0.3 to 1, with an average of 0.79. Tidal Volume was ranged from 6 to a maximum of 10ml/kg, increased as and when required. Average was 8.39ml/kg (Table 5).

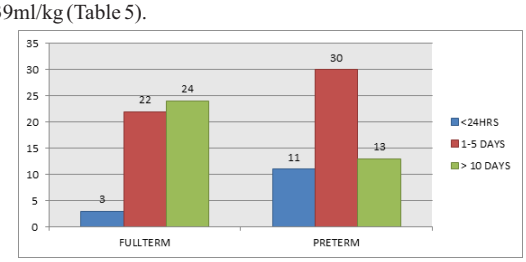

Fig 6.1: Duration Of Ventilation According To Gestation

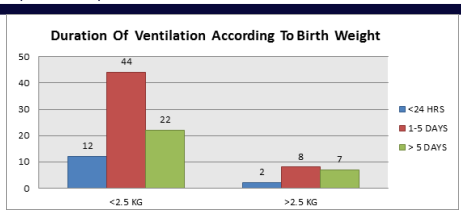

Fig 6.2 : Duration Of Ventilation According To Birth Weight

According to birth weight, Low birth ventilated for <24hrs, 1-5 days and > 5 days were 12, 44 and 22 respectively, while birth weight >2.5kg who were ventilated for <24hrs, 1-5 days and > 5 days were 2, 8 and 15 respectively (Fig 6.1, Fig 6.2).

Table 6: Complications of ventilation:

Complication	No. of patients	Percentage
Ventilator associated Pneumonia.	18	48.7%
Sepsis	15	40.54%
Pneumothorax	6	16.2%
Atelectasis	4	10.9%
Total	37	35.9%

Table 7: Distribution of neonates with VAP:

Complication			
Ventilator associated pneumonia	<24hrs	1-5 days	>5 days
Total number of neonates	0	2	16

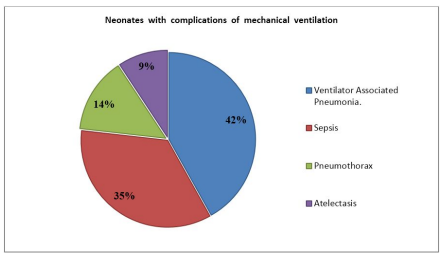

Fig 7: Complications of ventilation

Complications were seen in 37 (35.9%) neonates. The most common complications was Ventilator assocsiated pneumonia which was reported in 18 neonates (48.6%), sepsis in 15 neonates (18.9%) and pneumothorax in 6 neonates (16.2%). Some neonates with VAP and pneumothorax also had sepsis as complications of ventilations. In this study, out of 18 neonates who developed Ventilator associated pneumonia, 16 neonates (88.9%) were on ventilation for more than 5 days (Table 6,7; Fig7).

Blood Culture was positive in 23 neonates (22.3%). Most common organism reported was Pseudomonas, in 8 neonates (40%), Klebsiella in 5 neonates (25%), Acinetobacter species in 4 neonates (20%) (Fig 8).

Table 8: Blood Culture:

Sr. No.	Blood Culture Positivity	Total Number	Percentage
1.	Positive	23	22.33%
2.	Negative	80	77.66%
	Total	103	100%

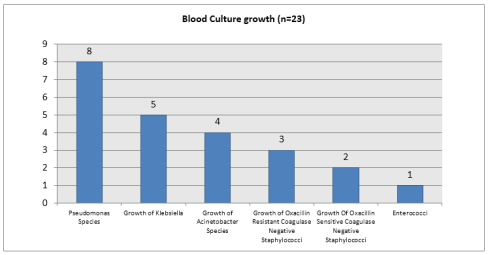

Fig 8: Blood culture growth

DISCUSSION:

- Assisted ventilation is the single most important advancement in neonatal medicine which has reduced neonatal mortality.
- Neonatal assisted ventilation has revolutionized the outcome of sick newborns in Intensive Care units.
- Respiratory disorders are the commonest cause of major neonatal morbidity requiring intensive care [1]
- It is possible to increase survival of neonates and improve the quality of life only through prompt and adequate management of neonates which is not possible without respiratory intensive care and assisted ventilation.
- Thus, It has become essential and mandatory to establish neonatal advanced life support facilities in neonatal intensive care units to enhance newborn survival.
- In the present study, 12.28% of neonates required mechanical ventilation.
- Nangia et al[7], Mathur et al[8] and P.K.Riyas et al[9] and NK Mittal et al[10] reported that 8.9%, 13%, 5.6% and 10.6% of the babies admitted in their nursery required mechanical ventilation.
- In this study, out of 103, 57.28% were males while females were 42.72%, p value not being statistically significant.
- In a retrospective study conducted by **Shah et al[11]** (2012), at a grade IIIA NICU in the Neonatal Intensive Care Unit of a tertiary care teaching hospital in the eastern part of Nepal to identify the clinical profile, pattern of disease, and outcome of patients, a total of 361 neonates were admitted in NICU during the study period, 65.6% were male and 34.4% were female, similar to our study.
- Sex at admission did not have a statistically significant association with the outcome as was found by **Kollef et al[12]** and **Riyas et al[13].**
- In a study done by **Iqbal et al[14]**, out of 300 neonates, 156 were male (52%), while 144 were females.
- Gestation wise 52.4% of neonates mechanically ventilated were Preterm while 47.6% of neonates were fullterm.
- A large proportion of premature infants require mechanical ventilator support due to development of respiratory distress syndrome at birth.
- **Sharma et al[15]** (2013) did a prospective and cross-sectional study in tertiary care centre, at Narayana Hrudayalaya, Bangalore, and found that, out of 72 ventilated neonates, 48 neonates (66.66%) were having Low Birth Weight and 24 (33.33%)were with normal birth weight.
- In this study, 47 babies (45.63%) were born via LSCS, Remaining 56 (54.36%) were born via Vaginal Delivery.
- A Study of Early Predictors of Fatality in Mechanically Ventilated Neonates in NICU at Gujrat was done by **Trivedi et al[3]** 2009 and found that out of 50 ventilated neonates, 42 (84%)were vaginally delivered and 8 (16%) were delivered by Cesarean section.
- In the study by **Bhatt et al[16].** Majority (90%) of the mechanically ventilated newborns was above 32 weeks of gestationand delivered vaginally (76.5%).
- Asphyxia was the most common indication of mechanical ventilation in 30.10% neonates followed by Neonatal Sepsis in 21.35% neonates.
- In a Prospective observational study done by **Shah et al[11]** 2013 on Mechanical Ventilation in Neonates: 2 Experience at a 3 Tertiary Care Center in Eastern Nepal, of total 88 neonates, Birth asphyxia (34%), sepsis (30.8%), MAS (20%), congenital pneumonia (10.8%) and hyaline membrane disease (HMD) (4.6%) were the common diagnostic conditions for which babies received mechanical ventilation.
- In a retrospective study by **Mannan et al[17] (2014)**, Respiratory Distress Syndrome (62%) was the commonest indication for ventilation followed by Neonatal Sepsis (14%), Perinatal Asphyxia (10%), Congenital Pneumonia (8%) and Pneumothorax (6%).
- 13.59% neonates required ventilation for <24 hours. 50.48% neonates required ventilation for 1-5 days, out of which, fullterms comprised of 42%, and preterms 57% (Table A).
- According to birth weight, Low birth ventilated for <24hrs, 1-5 days and > 5 days were 12, 44 and 22 respectively, while birth weight >2.5kg who were ventilated for <24hrs, 1-5 days and > 5 days were 2, 8 and 15 respectively (Table B).
- In the study done by **Ashour et al[18]**, 75% of neonates were given ventilator support for a
- period of 1 week .
- Complication were seen in 35.92% of ventilated neonates.
- Of the neonates who developed complications ,Ventilator associated pneumonia was the most common complication in 48.64% neonates , followed by Sepsis in 40.54% and pneumothorax in 16.21%.
- In a Retrospective study by **Maiya et al[19]** (1993) on Mechanical

Ventilation Of New Borns: Experience From A Level II NICU, Pneumonia, sepsis and air leaks were the common complications of mechanical ventilation followed by intracranial hemorrhage and PDA.

- In the study by **Prabha et al**[20] (2014) on Outcome Of Ventilation In Hyaline Membrane Disease, of the total 100 babies ventilated, Shock, Sepsis and Disseminated Intravascular Coagulation were the most common complication observed.

CONCLUSION:

Judicial use of neonatal intensive care measures in a developing country can result in a reduction of morbidity and mortality.

As sepsis was one of the most common indication of mechanical ventilation steps to ensure asepsis are of paramount importance otherwise all efforts are doomed to failure.

The majority of baby kept in mechanical ventilator are secondary to preterm baby, birth asphyxia and Neonatal sepsis.

Strict aseptic measures followed as protocols in NICU, early oro-gastric feeding with expressed breast milk, judicious use of appropriate antibiotics, liberal use of disposable material and other strategies to prevent nosocomial infections may help to reduce sepsis.

Among the numerous commonly available variables studied, weight <2500 g, gestation <36 weeks, initial acidosis, presence of congenital malformation, presence of maternal complications were significant predictors of mortality in ventilated neonates.

The indications and treatment protocols should be laid down to achieve best results.

The success of the assisted ventilation lies in devotion, continuous involvement of trained, skilled and committed team consisting of nursing staff, biochemist, physiotherapist and neonatologist.

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